PERMISSIBLE
PORTABLE
ELECTRIC MINE LAMP

APPROVAL **No.10**

Issued for safety and for practicability

and efficiency in general service

to the

EDISON STORAGE BATTERY CO.

Facsimile of the Certificate of Approval received from the Bureau of Mines, Department of the Interior. The Edison Mine Lamp is the first to receive approval for Safety and for Practicability and Efficiency in General Service under Schedule 6A.

The Edison Mine Lamp with Cover removed from Case

The Edison Electric Safety Mine Lamp

IN February, 1915, the Bureau of Mines of the Department of the Interior approved the Edison Electric Safety Mine Lamp. While this approval is marked No. 10 the Edison Lamp is the *first to be approved for safety and for practicability and efficiency in general service* under the provision of Schedule 6A, the standard of the United States Government.

Almost exactly one hundred years ago Sir Humphry Davy, in a communication to the Royal Society, London, gave the principles of his safety lamp which to this day underlie the construction of all safety oil lamps. Before the feasibility of working the lower levels in coal mines was considered, candles or oil torches of the most primitive type were in general use. Even emery wheels revolving against a flinty substance were sometimes taken for illumination, throwing against the working face the feeble light obtained from the shower of sparks. These served their purpose until the deeper mine workings were reached and the presence of inflammable explosive gases produced a danger with which the mine officials were powerless to cope. The Davy Lamp was offered as a relief and accepted by the English Government.

The later history of mine lighting is one long series of experiments in improving the Davy Lamp—no other *practical* form of safety lamp has been produced until the perfection of the Edison Portable Battery and Electric Cap Lamp for Mining Purposes has come as the crowning achievement of a century's labors.

The greatest danger in mines today is from the use of unprotected flames wherever the deadly fire damp is likely to be encountered. Explosions resulting from open lights not only cause the immediate

death of the miners in the vicinity and the subsequent suffocation of the survivors by the fumes which follow, but originate conflagrations in both gaseous and non-gaseous mines. The annals of mining are over-crowded with accounts of financial losses and destruction of life due to these secondary disasters for which the Miner's Torch has been responsible.

To ignore the danger from explosive gases and fires in mines is one of the most flagrant violations of the fundamental rules of safety that exists in modern industrial operations. The opportunity for bettering the condition of the miner and giving him a less uneven chance of spending his rightful span of life among his fellows has until now been unavailable on account of the characteristics of the work itself. Artificial light is an essential which formerly could not be obtained with safety unless provided in such minute quantity as to seriously curtail production.

Much ingenuity has been shown in trying to adapt portable electric lamps to this work, but the stumbling block always has been the production of current for their operation. The only practical source of energy is naturally some sort of battery, and many attempts have been made to modify the old types of cells so that they would serve the purpose satisfactorily. The advocates of the primary battery soon found that the inherent defects of this type were greatly magnified when an endeavor was made to produce a portable form of small size and weight with sufficient capacity to keep an electric lamp burning any considerable time. Aside from this, the electrical energy is produced in a primary battery by the consumption of the zinc plates, so that there was constant expense and trouble for their renewal.

The primary cell was early eliminated from serious consideration, and experiments made with secondary or storage batteries have until lately been far from successful. The corrosive sulphuric acid which remained the standard electrolyte for storage batteries until Mr. Edison invented a practical form of alkaline battery, requires a container made of hard rubber or other equally fragile substance. The very nature of the material makes it practically impossible to keep such a vessel liquid-tight in severe service, with consequent damage to person and clothing by leaking acid and loss of light by the diminished capacity.

This loss of light occurring frequently has been the invariable experience of all those who have tried the lead-acid type of batteries in actual mining work and has had a most demoralizing effect upon

productive and efficient organization. Mining men know the real dangers from diminished illumination and the manifold troubles that result. It is absolutely essential that such conditions be eliminated.

As lead is the principal material in the older forms of storage battery, light weight was, of course, impossible, and the well-known mechanical and electrical weaknesses of the lead battery have prevented its practical application to this, the roughest class of work in the world. Efforts have been made to overcome these inherent defects by making the electrolyte in gelatinous form, but with no success, as the composition soon dries out and absorbs water afterward with difficulty. Cracks form and the sediment deposited therein short circuits the plates and ruins the cell. None of the leading storage battery manufacturers recommends this modification.

Interchangeable Cover removed from Case showing Batteries being watered by means of the Automatic Filler.

Lamp in use. The angle of illumination is well in excess of the 130 degrees required by the Government.

THEN came the Edison Alkaline Storage Battery with Nickel and Iron Elements and the problem was solved. The Edison battery is as great an advance over other batteries as the Edison incandescent lamp was over other illuminants. Its characteristics are so different from those of the many lead-acid batteries that a detailed description is given below for comparison with other types. Those familiar with the troubles of other batteries will see that all of them have been eliminated.

1. The elements, nickel hydrate and iron oxide, in an alkaline solution, are encompassed by a strong, nickel-plated steel container, hermetically sealed, except at one miniature outlet for the escape of the harmless and odorless gases when being charged.
2. This small outlet is at one end of a steel tube which extends downward from the top of the container to within a half inch of the top of the electrolyte. Furthermore, this tube is so formed at the bottom that it prevents escape of the solution, even when the cell is violently shaken or even inverted.
3. When the cell is upside down, the tube projects far above the top of the solution. Therefore, it may remain in that position indefinitely.

With the Edison Lamp the miner's hands and arms are free, his illumination is ample and the approval of the Bureau of Mines stands between him and danger.

4. When the cell is laid on either its broad or narrow side, the tube is still above the solution.
5. The gases from the Edison Cell, given off on charge, do not carry with them any noxious fumes to corrode the cell parts, carrying case or surrounding apparatus or make it dangerous or unpleasant to operators in the vicinity. No special charging room is required no matter how many lamp batteries are being charged at once.
6. No injury is done the Edison Cell when over-charged for a short or prolonged period.
7. There is no injury done by leaving the Edison Cell in a charged, semi-charged, or discharged condition for an indefinite period.
8. Even though the cell be accidentally charged backward—in a reverse direction—no injury is done. It must be charged in the proper direction, however, to render service.
9. The steel container of the cell itself is proof against rough handling. The carrying case is made of steel—light, strong, non-rusting and of great wearing qualities.

10. Specific gravity readings are not necessary. If the electrolyte is emptied out and replaced with new every nine or ten months of continuous daily service, perfect operation is assured. The electrolyte is a simple, inexpensive alkaline solution made by the Edison Storage Battery Company and supplied ready to be put in the cells. The cost of renewing the solution is practically negligible—there are *no* plate renewals.
11. There are no insulation troubles in the Edison Electric Safety Mine Lamp, because when only two Edison Cells are used in a battery, they may be placed together without any insulation whatever. In fact, the approved construction consists of grounding the positive terminal of one cell to its can, grounding the negative terminal of the other cell to its can, then connecting the two cans together electrically. The battery of two cells, thus connected, may, obviously, be placed in a metal container without the introduction of any insulating walls. A rugged and practical arrangement is thereby obtained that may be placed in the hands of unskilled laborers without fear of injury and rapid deterioration.
12. The only attention necessary consists of charging, replenishing the electrolyte with distilled water to make up for loss by evaporation, etc., and keeping clean the exterior of the cell within the case.
13. There is no sediment to be dug out; no renewing of plates or separators; no buckling or growing of plates. Nothing but a practical steel tank for the storage of electrical energy for use when and how the operator sees fit.

Construction and Operation

THE illumination produced, as approved by the Bureau of Mines, is ample, *and is delivered in unvarying amount throughout the full working period.* The voltage is high (2.5 volts) and the wattage is low, requiring about 12 watt hours to give twelve hours' efficient service. The safety devices are perfect and, like the mechanical construction, will withstand the roughest usage.

THE BATTERY AND CASE.—The Edison Nickel-Iron-Alkaline Storage Battery Cells for the Mine Lamp are similar in construction to the larger cells used to operate mining locomotives, electric vehicles, railway train lighting, etc. Their tubes, pockets, grids, cases, etc., are all made of high-grade, nickel-plated steel. The active material of the positive plates is nickel hydrate held in perforated steel tubes, and the active material of the negative plates is iron oxide held in perforated steel pockets. The operations and reactions on charge and discharge give a complete chemical cycle and there is no appreciable mechanical, electrical or chemical deterioration.

The cells fit snugly into a light case of *rust-proof steel* which is primarily a box in which to carry the battery. There is no insulation between the cells and the case and the contact springs on the cell poles hold the battery securely when the cover is in place. The cover has a separable hinge which permits its entire removal when open and facilitates charging the batteries in "banks." Covers and cases, equipped with self-contained locks, are interchangeable.

The two cells are connected in series, the positive pole of one and the negative of the other being grounded to their containers, and the containers connected together. The free terminals carry the spiral contact springs which press against nickeled-steel contact plates in the cover. The contact plates are insulated from the cover and receive the cable terminals.

THE FLEXIBLE CABLE.—A twin-conductor, rubber-covered cable connects the battery to the cap lamp. At each end the cable is thoroughly armored, preventing injury from sharp bending. While lamp and reflector are being carried in the hand or at other times the armor takes up all the weight so there is no possibility of strain coming upon the wires at the terminals. An ingenious arrangement permits the easy replacement of the cable should it be cut or otherwise injured in service.

THE CAP LAMP.—The Cap Lamp consists of a nickel-plated brass reflector provided with a hook to fit into the regulation miner's cap. A Tungsten Lamp is forced into a spring socket by means of a clip at its tip in such a way that if the lamp be broken the base is immediately disconnected and the lamp extinguished. This safety feature has been throughly tested by the Bureau of Mines and unqualifiedly approved under Schedule 6A.

The reflector is finished on its face by a special process to increase reflection and is designed for ample and efficient illumination, having an angle of practical distribution considerably greater than the 130 degrees required by the Government.

The lens is a piece of plain glass with parallel surfaces, easily replaced if broken.

The design gives to the head-piece the greatest amount of clearance as shown in the illustrations. Head-room to the extent of half the diameter of the reflector is gained—a decided advantage in mine galleries.

METHOD OF ATTACHING.—The miner straps the battery case to his back by his ordinary belt. The lamp is attached to the leather support in his cap, leaving his arms entirely free of lamp, cord and battery case.

When the case is locked and the lamp handed to the miner charged and "burning" there can be no safer or surer means of illumination.

AUTOMATIC FILLER.—The Filler shown on page 5 has been specially designed for "watering" the cells of the Edison Mine Lamp. The use of this filler saves time and insures proper filling, as it indicates when the normal level has been reached and, automatically, cuts off the flow of water at that point. It can be used in the same way for renewing the alkaline battery solution.

The Edison Electric Safety Mine Lamps

Electrical Data, Dimensions, Weights, etc.

Type of Cell	M8
Number of Cells per Battery	2
Capacity, ampere-hours	4.5
Hours Burning per Charge	12
Normal Charging Rate, amperes	1.0
Length of Charge, hours	8
Average Voltage of Discharge at 12-hour Rate	2.5
Weight per Cell, ounces	16
Total Weight of Battery in Case, ounces	44.0
Total Weight of Battery, Case and Lamp Complete, ounces	60.0

Approximate Dimensions of Cell, in Inches:

Height to Top of Filler Cap	6¼
Height over Contact Springs	6½
Horizontal Dimensions	1⅜x2½

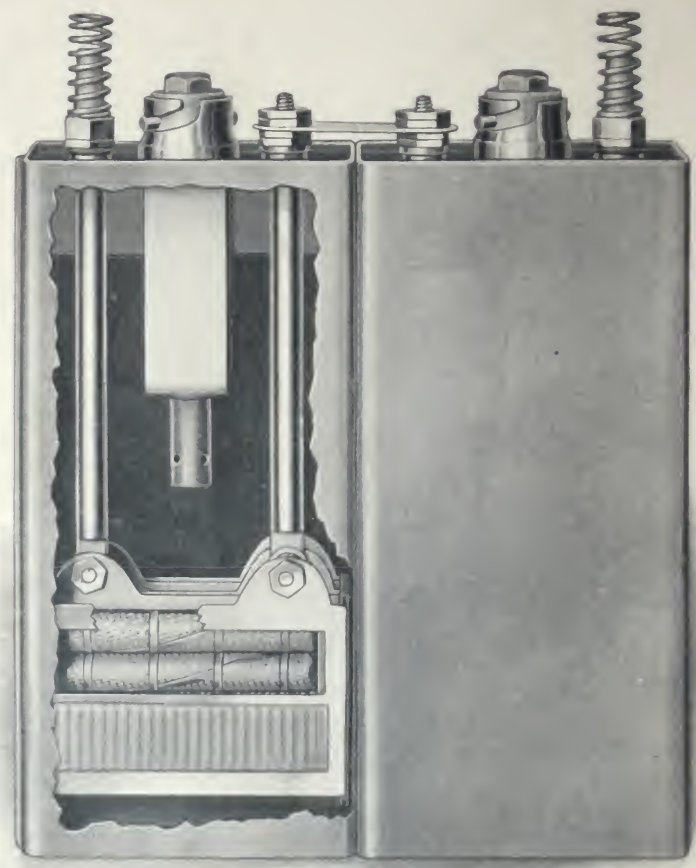
Approximate Dimensions of Battery Case, in Inches:

Height	6¾
Horizontal Dimensions, over all	1¾x5⅜
Standard Renewal Solution per Battery (2 cells), pounds	½
List Price of Safety Lamp, complete with one bulb, f.o.b. Orange, N. J., each	$11.00
List Price Type M Automatic Filler	1.50

Quantity discounts on application.

All prices f. o. b. Orange, N. J., and subject to change without notice.

Various other types of small battery lamps, such as hand lamps, etc., are in preparation. A Type M20 Edison Cell using similar plates to the Type M8 and having a capacity of 12 ampere hours is also made. This is suitable for small stationary lamps, motorcycle ignition and lighting, small gas engine ignition, time clock systems and any service where a small, rugged battery is required.



The two cells of the Edison Electric Safety Mine Lamp removed from their steel case. The steel container of one cell is cut open to show the method of assembly.

The positive plates (steel tubes of nickel hydrate) and negative plates (steel pockets of iron oxide) are assembled on steel poles and intermeshed; thus giving an especially compact, strong construction not found in batteries made of less rugged materials. The solution being non-acid, an all-steel construction such as this is possible.